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Final Report on ONR Award N00014 -88 -J- 1050

Report on a workshop "**Hardware Implementation of Neuron Nets and Synapses**" San Diego, CA, January 13-15, 1988.
Principal Investigator: Paul Mueller

Summary of Completed Project:

Purpose:

The workshop brought together 35 key investigators in this area and several representatives from funding agencies, with the aim to assess the current state of the field, to explore the potential for existing and new approaches and to identify those areas that provide currently the greatest opportunities and may need particular emphasis.

Assessment:

It was evident from the high quality of the presentations that the field is making excellent and rapid progress. This is especially so for the special purpose systems that are modeled after biological sensory input systems such as retinas, cochleas and networks for sound localization. The development of larger systems fore more complex problems such as vision, speech recognition, tactile sensing and robotics lies still in the more distant future. It was agreed that the field should make use of currently available technologies although research into new materials, devices and interconnection methodology should be continued at an active level.

Technical Information:

The specific discussion topics were grouped into several categories:

<u>1. Modifiable Synapses</u>

This section explored approaches to building devices that realize variable synaptic weights, typically through a controlled conductance. Several speakers presented designs and tests of both analog or digitally controlled Synapses.

In the first category are devices that make use of floating gate technologies or solid state electrochemistry.In the second category are devices in which synaptic gains are set by digital signals and the designs are essentially based on existing DAC technology.

Although all the devices mentioned above have either been fabricated and tested or are awaiting return from the foundry, it is difficult at this stage to evaluate their performance in a larger system.

II. Technologies and Systems

Two sessions were devoted to discussions of larger systems implemented by different technologies. Novel low powered circuits were presented in which computations are performed by currents and which may be useful as elements in neural systems. Several VLSI neural circuits for low level vision processing and for the recognition of visual (black and white) primitives and their application to recognition of hand written numerals were discussed.

Another topic concerned the application of neural circuits to real time speech recognition. The analysis of speech and motion involves explicitly patterns in the time domain and several approaches for dealing with temporal patterns and the implementation of such algorithms in neural hardware were presented.
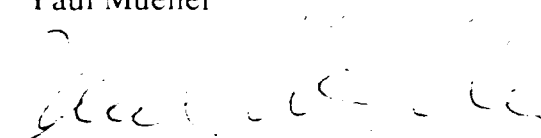
A final session was devoted to the implementation of neuron networks by optical and electro-optical technologies. In these technologies connections are made by light and synaptic weights are stored in holograms or through spatial light modulators.

Publications:

Mueller,P., Hopfield,J., Lau,C. Mead, C., Report on a Workshop #Hardware Implementation of Neuron Nets and Synapses#. IEEE Circuits and Devices Magazine, 4(3) : 23 -24, 1988.

 In addition a 400 Page report of the individual contributions of the participants was distributed to participants and interested parties.

Paul Mueller

Principal Investigator

5/26/91

Final Patent Report on ONR Contract N00014-87-J-1050

Workshop on "**Hardware Implementation of Neuron Nets and Synapses**" San Diego, CA, January 13-15, 1988.
Principal Investigator: Paul Mueller

No Patents have been issued or were applied for or.

Paul Mueller

Principal Investigator

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